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IRIDESCENT COLOR IN PERISTERITE*

A. L. PARSONS, *University of Toronto.*

On this tenth anniversary of the founding of the *Mineralogical Society of America* your president has selected as the topic of his address a field of study in which much fruitless work has been done, and where very little is known. Many terms such as labradorescence, opalescence, iridescence and scattering of light have been applied to the peculiar color phenomenon that is probably best known in labradorite, one of the first minerals to be described from this continent. The last worker in this field after much excellent work frankly acknowledged defeat in trying to reach a satisfactory explanation for the colors. A century and a half has elapsed since labradorite was named and in this period of time no satisfactory explanation of the iridescent color, based on sound physical laws, has appeared.

Inasmuch as the interpretation of the phenomena observed is somewhat radical and may have far-reaching results, the writer has consulted his colleagues in the Department of Physics in the University of Toronto who have assured him that they see nothing in the interpretation that is unsound from a physical point of view.

The subject was selected because during the past summer the writer collected a quantity of peristerite near Hybla, Ontario, which exhibits iridescent color in a remarkable degree. While examining the material it was seen that this color was not visible under ordinary conditions of reflection but that in certain cases the incident light and the reflected iridescent light were both on the same side of the normal to the reflecting surface, while at the same time there was an ordinary reflection with equal angles of incidence

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and reflection. In only two positions was the plane containing the incident white light and the iridescent reflected light perpendicular to the visible reflecting surface. This peculiar optical behavior of the peristerite led the writer to look up the literature bearing on the subject of iridescent colors, more particularly in connection with the feldspars, with the result that he decided to outline our present knowledge of this subject with the addition of certain conclusions of his own.

The same or a similar phenomenon is to be observed in other minerals and artificial crystals, but as it is possible that an explanation that seems good for this mineral may not apply to all, the final discussion is limited to peristerite.

Although certain theories have been advanced to account for these iridescent colors there has been no adequate explanation, nor until quite recently was there any sound basis for reaching a satisfactory conclusion.

It is probably safe to say that no work based on measurements was done on this problem before 1827 when von Hessel did his first work which was mentioned by Nordenskiöld as being the first real effort to solve the problem, so that in general we will not include in our summary of work done the conclusions that were reached without measurements.

Von Hessel¹ who studied this phenomenon in 1827 later made a two circle goniometer and showed not only that the iridescent light was reflected in definite positions but that when the crystal was turned so that the reflecting plane was perpendicular to the polar axis of his instrument the reflection did not disappear in a complete rotation about this axis. He attributed the color to reflections from inner cleavage planes.

Brewster² determined that the iridescent color in labradorite was reflected from a plane which made an angle of $10^{\circ}52'$ with the cleavage face *P*. He attributed the colors to reflections from an infinite number of planes and showed that the color of the transmitted light was complementary to that which was reflected.

In showing the path of the light he fails to realize that with his construction there is no possibility of the emerging ray interfering with an incident ray as he assumes normal refraction at the cleavage plane whereas the refraction must be at a plane or

¹ *Kastn. Arch. Nat.*, 1827, 10, 273; *Pogg. Ann.*, 1850, 79, 443.

² *Trans. Roy. Soc. Edinb.*, XI, 322-331, 1829.

pair of planes parallel to the plane of reflection if there is to be interference.

N. Nordenskiöld³ working with labradorite from Finland determined the position of the plane giving the iridescent reflection and attributed it to cleavages. His material exhibited a zonal arrangement of color which requires further study. The same zonal arrangement was later observed by Schrauff.⁴ He also demonstrated that the refractive index was involved in the phenomenon and showed his idea of the path of the light. His most important conclusion was that the atoms of transparent crystals can be

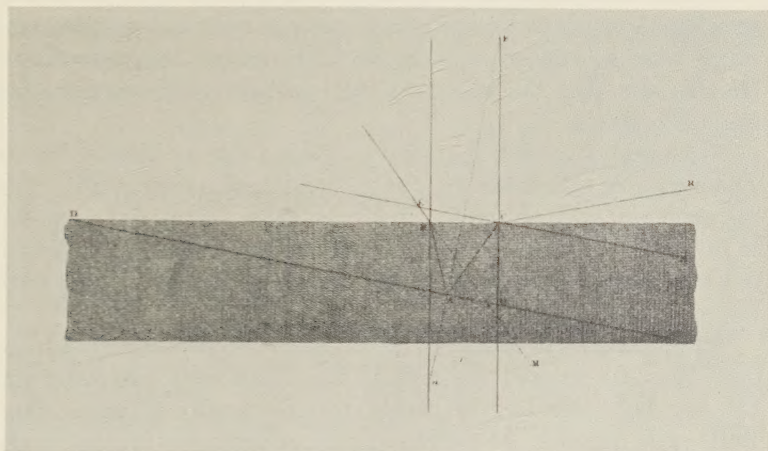


FIG. 1.

arranged for the refraction of light in different ways. With no other foundation and presumably with many doubts and mental reservations, he enunciated the principle that is essential to a logical explanation of iridescent reflections from crystals, but unfortunately in showing the path of the light he used the same general construction as that employed by Brewster.

In the century that has elapsed since Nordenskiöld enunciated this important principle there is no worker in this field who has shown such sound reasoning. It remained for von Laue and a host of workers with X-rays to bring additional information showing

³ *Kongl. Vet. Acad. Handlinger*, 1829, 42; *Pogg. Ann.*, 1830, 19, 179, translated by J. Senff.

⁴ *Sitzungsb. Akad. Wiss., Wien*, 60, 996-1053, 1869.

that reflections can be obtained from a multitude of atomic planes which in general do not coincide with the visible surface.

Senff⁵ observed in "Finnish labradorite" that the iridescent color was visible when the crystal was turned $22\frac{1}{2}^{\circ}$ from the position when the second cleavage, (010), gave its normal reflection.

Bonsdorff⁶ attributed the play of colors to very fine and uniform particles of quartz because the labradorite with a play of colors contained more silica than others. This was in the days before the use of the petrographic microscope and was merely *ex cathedra* argument.

Reusch⁷ assigned indices to the planes that reflected the iridescent light in labradorite and attributed the reflection to cleavages which were so minute as to be invisible under the microscope. He also said that the color was very probably a low order color from thin plates.

Vogelsang⁸ regarded the common blue color of labradorite as a polarization phenomenon due to its lamellar structure, while the golden or reddish schiller, with the other colors, was supposed to be due to the presence of black acicular microlites and yellowish red microscopic lamellae or to the combined effects of these with the blue reflections.

His contention is sound so far as polarization is concerned; for light that has entered the crystal must be doubly refracted and the two rays polarized in planes at right angles to each other. Both rays, however, on reflection emerge from the crystal in the same phase and, in consequence, as was later shown by Stokes, there is no evidence of polarization to be seen with an analyzer.

O. Anderson⁹ in his paper on Aventurine Feldspar says:

"Aventurine feldspars (sunstones) should be sharply distinguished from the other group of color-playing feldspars known as moonstones, murchisonites and labradorites. These feldspars are characterized by a rather subdued, generally bluish or greenish play of colors ("glaukisiren") which is not caused by any visible lamellae but perhaps by submicroscopic inclusions. The colors are probably due to scattering of light by particles

⁵ *Pogg. Ann.*, 1829, **17**, 352.

⁶ *N. Jahrb.*, **1838**, 681.

⁷ *Pogg. Ann.*, 1863, **120**, 95.

⁸ *Arch. Néerland.*, **3**, 32, 1868.

⁹ *Am. J. Sci.*, (IV), Vol. **40**, p. 351.

smaller than the wave length of light, and cannot be explained as ordinary colors of thin films."

Stokes¹⁰ as the result of the examination of crystals of chlorate of potash enunciated the following points:

- (1) If one of the crystalline plates be turned round in its own plane, without alteration of the angle of incidence the peculiar reflection vanished twice in a revolution, *viz.*, when the plane of incidence coincides with the plane of symmetry of the crystal.
- (2) As the angle of incidence is increased the reflected light becomes brighter and rises in refrangibility.
- (3) The colors are not due to absorption, the transmitted light being strictly complementary to the reflected.
- (4) The colored light is not polarized.
- (5) The spectrum of the reflected light is frequently found to consist almost entirely of a comparatively narrow band. In many cases the reflection appears to be almost total.

In discussing the cause of the phenomenon he attributed it to twin lamellae of definite thickness.

Rayleigh,¹¹ in discussing Stokes' work, concluded that the iridescent colors in potassium chlorate crystals came from a large number of reflecting surfaces at regular intervals which he concluded were twin planes. He also showed that in Iceland spar, in which polysynthetic twinning had been artificially induced, iridescent color was to be seen but not when the plane of the incident light coincided with a plane of symmetry of the crystal.

Rayleigh, the younger, shows that the crystals of potassium chlorate were twinned¹² and points out that the colors do not appear at strictly normal incidence.¹³ He also shows that mother of pearl consists of alternating layers of calcite and horny matter.¹⁴ In examining labradorite he established a definite plane of reflection for the iridescent light¹⁵ which he distinguished from the reflections from inclusions. He, however, failed to assign indices to the reflecting plane.

¹⁰ *Proc. R. Soc.*, **XXXVIII**, 1884-85, 174-185.

¹¹ *Phil. Mag.*, Vol. **26**, pp. 256-265, 1888.

¹² *Proc. Roy. Soc.*, Vol. **102**, pp. 668 et seq., 1923.

¹³ *Proc. Roy. Soc.*, Vol. **102**, p. 676, 1923.

¹⁴ *Proc. Roy. Soc.*, Vol. **102**, pp. 675 and 677, 1923.

¹⁵ *Proc. Roy. Soc.*, Vol. **103**, p. 37, 1923.

Bøggild, in his treatise on the Labradorization of the Feldspars,¹⁶ states that in the plagioclases this phenomenon is found in only two groups having the composition $92\frac{1}{2}$ to $85\frac{1}{2}$ and 49 to 38 per cent of albite by weight, though the tabulation of his measurements fails to show perfect agreement with his statement. He points out that in the peristerites there is a single plane which gives colored reflections, while with the labradorites there are three planes. Usually only one plane is observed in labradorite but some specimens show two planes which may be any combination of the three possible planes. No case is mentioned where all three planes are shown on a single specimen.

He also observed that the material was either twinned or laminated. To the reflecting plane in albite (peristerite) he indicates positions to which he assigns indices corresponding approximately to $(08\bar{1})$ and $(\bar{1}.21.\bar{2})$. He, however, failed to find a cause for the iridescent color and says:

"Labradorization is the peculiar reflection of the light from submicroscopical planes orientated in one direction (rarely in two directions); these planes have never such a position that they can be expressed by simple indices, and they are not directly visible under the microscope.

"It must of course be considered perfectly enigmatic what can produce the labradorization in the plagioclases, and equally impossible to explain the peculiar orientation of the lamellae which produce that phenomenon. It is not possible to find any cause for the orientation of the lamellae in these peculiar directions, and there is no other property, neither crystallographical nor optical, which can be connected with them."

An extremely important contribution to our knowledge is, however, given by Bøggild in his concluding paragraph where he points out that gedrite from Avisiarfik in Greenland gives iridescent color from the reflecting plane (010) , and that the substance is perfectly homogeneous and there were no reflecting intercalations visible under the microscope. In this case it would appear that twinning does not enter as a factor.

For the solution of the problem Bøggild's work is by far the most important recent contribution as he relates the phenomenon to chemical composition and definite crystal planes.

¹⁶ Kgl. Danske Videnskab. Selskab., *Math.-Fys. Medd.*, VI, 3, 1924.

Summarizing the essential points that have been discovered in the past century we find:

- (1) Iridescent color in crystals is reflected from definite crystallographical planes.
- (2) In most cases the material that has been examined was twinned.
- (3) The colors are interference colors usually of the first or second order.
- (4) The color of the iridescent light is complementary to that of the transmitted light at a given angle of incidence.
- (5) The colored light is not plane polarized.
- (6) The atoms of crystals can be so arranged that light will be refracted in different ways.
- (7) The iridescent colors in plagioclase are shown only by those of certain chemical composition.

In looking over the established points the writer has been impressed with the fact we have here all the essentials for a logical explanation of the phenomenon.

In approaching the solution of the problem it may be assumed (until disproved) that the ordinary laws of optics hold. If these laws do not apply then they are no longer general laws but special cases of more general laws. Three of these laws that apply are:

- (1) The law of reflection:

The angle of incidence = the angle of reflection.

- (2) The law of refraction (Snell's law):

$$\sin i / \sin r = n.$$

- (3) The law for interference:

$$n\lambda = 2t\mu \cdot \cos i.^{17}$$

For purposes of comparison with more recent crystallographic work the last formula may be written:

$$n\lambda = 2t\mu \cdot \sin \theta,$$

¹⁷ The laws just mentioned have been derived largely by testing isotropic material. At least two of them require a more general expression when applied to anisotropic media and there is disagreement as to the third. This has been taken into consideration in the discussion that follows. The really important point is that light, which has entered a plane parallel optical system, will on emerging follow a path which is parallel either with the incident ray or with the ray that is reflected from the first surface.

which is fundamental in the study of crystal structure by means of X-rays but as in this case the index of refraction is approximately unity, it has been modified by Bragg to the form:

$$n\lambda = 2d \cdot \sin \theta,$$

where d is the spacing between similar atomic planes. With monochromatic X-rays we get in this instance a monochromatic interference reflection. At other angles there is no reflection until suddenly we get a reflection of another order.

With glass and other amorphous substances the conditions for interference colors are met when:

$$n\lambda = 2t\mu \cdot \sin \theta.$$

The same formula will also apply to crystallized substances, but as:

$$t = md,$$

we can modify our formula so that it reads:

$$n\lambda = 2md\mu \cdot \sin \theta.$$

Of equal importance in approaching the solution is the formula which correlates the specific gravity, molecular weight, size of unit cell and the number of molecules in the unit cell

$$10^{-24} \times \text{S.G.} \times abc = N(\text{mol. wt.}) \times 1.65 \times 10^{-24}.$$

From our knowledge of the dimensions of the unit cells of crystals we can safely say that there is no possibility of interference reflections from single cells with ordinary light. A thickness such that we can obtain a retardation of a wave length of visible light is necessary, and in general it is by no means certain that an atomic plane that gives interference reflections with X-rays will give a reflection with ordinary light or that the reverse will hold.

The results obtained by numerous workers with X-rays show that we obtain interference reflections from a multitude of crystallographic planes which in general are placed at an angle to the visible reflecting surfaces. The work of von Hessel, Nordenskiöld, Brewster, Senff, the Rayleighs, and Boggild has demonstrated that iridescent color is produced by reflection from definite crystallographic planes which in general make an angle with the apparent reflecting surface.

Inasmuch as we have interference reflections from definite crystallographic planes both with X-rays and with visible light we adopt the hypothesis that the laws governing both phe-

nomena are the same. We may then write the formula governing interference colors by reflection from crystals as:

$$n\lambda = 2md\mu \cdot \sin \theta.$$

The peristerite which is used for the present discussion was obtained from a feldspar quarry in Monteaule township, Hastings County, Ontario, where it is associated as a minor constituent with green microcline, flesh red microcline, quartz and biotite, and is of pegmatitic origin. It is twinned after the albite law so that a series of fine striations is visible on the basal cleavage. It also exhibits at times pericline twinning of a remarkable character so that it is readily seen in a hand specimen on the (010) cleavage. (Fig. 2).

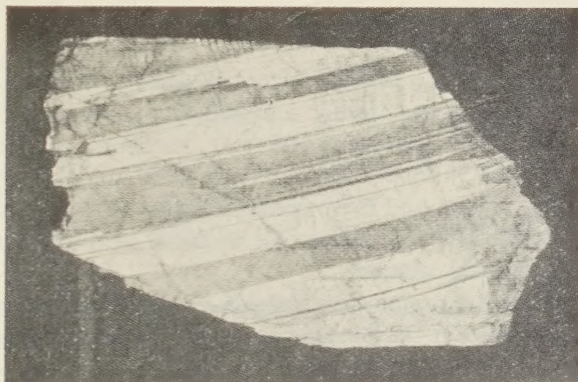


FIG. 2.

In the specimen that is illustrated the pericline lamellae have a maximum thickness of about half an inch.

The angle between the trace of the pericline twinning on (010) with the edge between (001) and (010) is 15° . The extinction in a plane perpendicular to (001) and (010) is 10° . Both these observations indicate a plagioclase with approximately 90 per cent albite.

In some of the specimens the central portion is iridescent while the outer border for a width, in some cases, of three fourths of an inch is non-iridescent. Occasionally there are iridescent portions in this outer zone. In view of Bøggild's statement that the peristerites contain about ninety per cent of the albite molecule, a sample of the iridescent portion of one of these specimens was carefully prepared and analyzed by M. C. Haller, research assistant

in the Department of Mineralogy, University of Toronto, with the following result:

	Per cent	Mol. pts.	Ab	Or	An	H ₂ Al ₂ Si ₂ O ₈	Excess
SiO ₂	66.25	1.104	.942	.096	.044	.002	
Al ₂ O ₃	20.94	.205	.157	.016	.022	.010	
Fe ₂ O ₃	0.34	.002					.002
CaO	1.23	.022			.022		
MgO	0.00	—					
Na ₂ O	9.74	.157	.157				
K ₂ O	1.50	.016		.016			
H ₂ O	0.20	.011				.011	
	100.20						
Percentages			82.27	8.90	6.12	2.64	.34
S.G.	2.631						

This corresponds to 82.27 per cent of albite and 8.90 per cent of orthoclase or if we consider orthoclase as equivalent to albite we then have 91.17 per cent which is in accord with Bøggild's statement. The ratio of albite-orthoclase to anorthite is almost exactly eight to one and if we consider water to be equivalent to lime it is five to one. In either case we have a condition for a definite molecular arrangement.

For purposes of comparison another carefully prepared sample of the non-iridescent portion was analyzed by Mr. Haller and the results together with the recalculation follow:

	Per cent	Mol. pts.	Ab	Or	An	H ₂ Al ₂ Si ₂ O ₈	Excess
SiO ₂	66.72	1.111	.942	.072	.028	.018	.051
Al ₂ O ₃	20.98	.206	.157	.012	.014	.009	.014
Fe ₂ O ₃	0.31	.002					.002
CaO	0.81	.014			.014		
MgO	0.00	—					
Na ₂ O	9.74	.157	.157				
K ₂ O	1.12	.012		.012			
H ₂ O	0.16	.009				.009	
	99.84						
Percentages			82.27	6.67	3.89	2.16	4.80
S.G.	2.628						

An interesting feature of this analysis is the percentage of albite which is exactly the same as in the iridescent material. The per-

centages of orthoclase, anorthite and $\text{H}_2\text{Al}_2\text{Si}_2\text{O}_8$ are all less. The striking difference, however, is in the excess of silica and alumina.

The ratio of albite-orthoclase to anorthite is 12 to 1 or, if we consider water as equivalent to lime, 8 to 1. The excess of silica and alumina, however, provides for a condition where a continuous regular molecular network would not be expected.

Measurement on the goniometer showed that a diffuse reflection was obtained from what is assumed to be an atomic plane which made an angle of $23^\circ 15' \pm 1^\circ$ with the (010) face.

The specimen was then adjusted with a prismatic edge parallel to the axis of the vertical circle and the following measurements made:

	ϕ	ρ	
(0 $\bar{1}$ 0)	180° 00'	90° 04'	
(010)	0° 02'	90° 04'	
(1 $\bar{1}$ 0)	118° 37'	90° 04'	
(110)	299° 12'	91° 00'	
(00 $\bar{1}$)	99° 43'	25° 21'	best base
(001)	81° 20'	25° 21'	
($\bar{1}$.15.3)	14° 50'	71° 23'	iridescent reflection

The accuracy of the readings is not such that exact indices can be assigned as the reflection from ($\bar{1}$.15. $\bar{3}$) is diffuse and the position is susceptible to a variation of a degree or more in both the ϕ and ρ angles.

When the plane of the iridescent reflections was brought to the polar position there was no change in intensity in a complete rotation of the vertical circle.

The color in different parts varies but cannot be due to any known cleavage, for with incipient cleavage the Newton color rings are to be seen with ordinary conditions of incidence. The difference in color, however, appears to be due to differences in the thickness of the twinning lamellae. The color appears to be due principally to the first lamella, though some specimens show a fainter color when turned so as to look at the second lamella from the corresponding crystallographic direction.

The writer's conception, based on the three fundamental laws of optics mentioned above, of the path of the light causing the iridescent color is shown in figure 3.

The cause of the color may be summed up as follows:

The atoms (probably of calcium) are so spaced as a network or grating that the plane $(\bar{1}.15.\bar{3})$ (AB) acts as a reflecting and refracting plane for visible light, though it is extremely doubtful whether it would give a reflection with X-rays.

On entering the crystal the incident ray IA is refracted normally on AB not on MN and proceeds to the twinning plane where it is reflected normally from A''B''. On emerging from the crystal it is refracted by A'B' and gives an interference color with I'A' which is reflected at the plane A'B' along the line A'R.

The particular tint of color is determined by the thickness of the twinning lamellae. This is shown more clearly on a polished surface where the crystal has been bent in places so that the thickness of the first lamella is not constant.

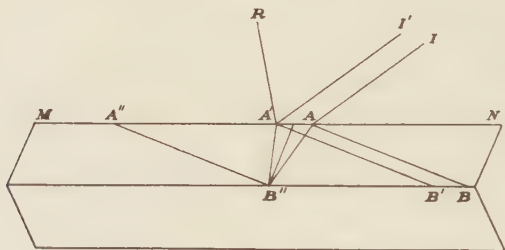


FIG. 3.

The common occurrence of twinning in the substances that exhibit iridescent color has naturally suggested that this plays an important part. Twinning provides for lamellae that are comparable in thickness with the wave lengths of visible light, and there is a discontinuity in optical arrangement at the twinning plane. Further than this the writer can see no reason for attributing the iridescent color to twinning.

In this paper an attempt has been made to give an explanation for iridescent color based upon well recognized laws. If the conclusions are incorrect there is a most attractive field to search for the fundamental laws of reflection, refraction and interference of light.

There are many points connected with iridescent color that remain to be solved. Many crystallized substances have been examined which exhibit this phenomenon. Where exact measurements have been made the color has been shown to be connected

with a definite crystallographic plane which in general makes an angle with the visible surface. In all cases it seems to be connected with a regular arrangement of atoms as was first suggested by Nordenskiöld.

The present paper is merely a beginning of the solution of the problems that are presented and it is premature to predict further developments but the field for study is extremely broad if we try to account for observed phenomena by physical laws.

If the laws of reflection, refraction and interference of light be correct, the work of numerous observers in the past century demonstrates most conclusively that visible light is refracted and reflected from atomic planes in crystals in a normal manner without reference to the surfaces.

THE FIRST TEN YEARS OF THE MINERALOGICAL SOCIETY OF AMERICA

EDWARD H. KRAUS, *University of Michigan.*

Ten years ago a group of twenty-eight interested in American mineralogy assembled in the Mineralogical Laboratory of Harvard University. This occurred while the Geological Society of America was in session in Boston. The object of the meeting was to discuss the advisability of organizing a society devoted to the advancement of mineralogy, crystallography, and allied sciences. This gathering was the culmination of a movement extending over a period of years to band together those interested in our science into an independent organization. It was thought that a society of this character would stimulate interest and research in mineralogy and crystallography and also tend to give to these sciences the recognition and standing they justly merit.

Accordingly, the formation of the *Mineralogical Society of America* was agreed upon. The constitution and by-laws were adopted, officers were elected for the ensuing year, and responsibility was assumed for publishing the *American Mineralogist* as the Journal of the Society. It was also voted that the lists of charter fellows and members should remain open for one year.

The interest that was at once manifested in the new organization was very gratifying and materially exceeded the hopes and expectations of those most enthusiastic in the movement for an independent society, for at the first annual meeting held in Chicago in 1920 it was reported that the Society had 48 charter fellows and 125 charter members.

During the organization year a very satisfactory plan for affiliation with the Geological Society of America was agreed upon, for it was ever in the minds of the advocates of the new Society to keep in close contact with what for some of us was the parent organization. This hope has been fully realized for the relationship between the two organizations is a very intimate and cordial one, and I believe that it has also been mutually beneficial. The recognition of the president of our Society as a vice-president of the Geological Society of America and the provision for a joint session at the annual meetings at which the retiring president of the Mineralogical Society shall give his presidential address have contributed in no small measure in developing this splendid relationship.

That there has been a continuing and, indeed, a growing interest in the Society is shown by the fact that we have today 114 fellows and 274 members. The mailing list for the *American Mineralogist* now totals 609. This growth in the membership of the Society has been truly remarkable, especially when one considers the large number of organizations in this country devoted to specialized phases of science.

From the very first the annual meetings have been very attractive and have accordingly made a strong appeal. Indeed, for several years the unusual record was maintained of being able to have all papers on the program read. Furthermore, there has been a satisfactory increase in the number of papers presented for reading and in the number of persons attending the various sessions, culminating in a record of 32 papers and a total attendance of 108 for the New York meeting last year.

Reference must be made to the very excellent work of the committees on *Nomenclature and Classification of Minerals* and on the *Preservation of Type Mineralogical Material*. These committees have devoted much time to the problems under consideration, and the carrying out of their recommendations should prove very helpful in the standardizing and unifying of mineralogical practice in America. The reports of these committees have stimulated interest in these phases of our science in other countries and led to the suggestion by Dr. H. S. Washington, in 1925, that efforts be made by the delegates from this Society to the International Geological Congress at Madrid to take steps leading to the formation of a Mineralogical Section of the Congress at which these and other problems might well be discussed. This was done, and it was hoped that some action might be taken at the Congress held during the past summer in South Africa. Unfortunately, however, little progress has been made in this direction. Consequently it has recently been suggested that perhaps through the co-operation of several of the leading mineralogical societies something definite and of real value internationally might be accomplished.

Perhaps the greatest factor in bringing the Society to the attention of the scientists of America and of the world has been the *American Mineralogist*. As is well known, this publication was founded in 1916 through the co-operation of the Philadelphia Mineralogical Society, the New York Mineralogical Society, and the

Mineral Collectors Association and was taken over by our Society when it was organized.

During the ten years under the new auspices the *Mineralogist* has grown greatly in size, from a volume of approximately 200 pages in 1920 and 1921, to one of 500 or more pages in recent years. During this period 485 longer original articles covering 2642 pages have appeared. The number of articles, abstracts, and news items totals 2302, and the ten volumes include 3385 pages. There are also 620 illustrations. When one considers that a great many mineralogical papers have been published in other journals this record of the *Mineralogist* would seem to indicate that there has been a notable increase in research activity during the decade.

From the standpoint of the number and the geographical distribution of the contributors it is of interest to know that in some years there have been over 40 authors who have represented as many as 30 institutions, and five different countries. The editor has succeeded admirably in giving a somewhat international character to the *Mineralogist* and I am sure that he would enthusiastically welcome an increasing number of articles from Canada, England, Germany, and other countries. This wide interest in the *American Mineralogist* as a medium for the publication of the results of mineralogical investigations is very encouraging.

During the first five years of the Society the progress made by our *Journal* was rather slow. A very real impetus to its development was given, however, in 1925 when the Council approved of the plan of permitting an entire number of the *Mineralogist* to be devoted to the publication of articles from a single institution, provided adequate financial support was guaranteed to pay for the added expense of the increased size of the number. Thus far only four special numbers have been issued. These have been sponsored by two institutions, one number by the University of Michigan and three by Harvard University. It is sincerely hoped that the practice of issuing special numbers will be continued and that more institutions will avail themselves of this plan.

That these enlarged special numbers greatly impressed our constituency in America and abroad there can be no doubt. They contributed materially in establishing the very splendid reputation the *Journal* now has in scientific circles. These numbers showed very clearly what might be accomplished with adequate financial support. Furthermore, the first two special

numbers which were issued in 1925 undoubtedly did much to convince the late Colonel Washington A. Roebling of the urgent need of an ample endowment for our Journal, for he had keenly sensed the fact that the Society and the Journal were greatly handicapped in their endeavors by a lack of funds.

Accordingly, in February 1926 Colonel Roebling notified our treasurer, Professor A. H. Phillips, that he desired to assist the Society in its endeavors by a gift of \$45,000. While in the past there have been notable gifts of extensive mineral collections to various institutions in the country, never before has so splendid an endowment been established for the encouragement and development of the science of mineralogy through the medium of a society and its journal. When the announcement was made of Colonel Roebling's action, mineralogists in America and abroad freely and gladly expressed their sincere appreciation of his generosity. In making this liberal gift Colonel Roebling contributed in a very large way to the advancement of American mineralogy, for the status of any branch of knowledge is largely determined by the character of its active organizations and current publications.

Since the hope was expressed by Colonel Roebling that all or part of the funds should be devoted to the development and expansion of the American Mineralogist the Society, in formally accepting the gift, pledged itself to carry out the wishes of the donor. Hence, when the income from the Roebling fund became available, the Council authorized the editor of the Mineralogist to pursue a more liberal policy in the conduct of the Journal. This had a most gratifying result, for the four volumes published since the Roebling gift have averaged over 450 pages. This average shows an increase of about 200 pages over that of the preceding six volumes. Moreover, the recent volumes contain a much larger number of illustrations.

That the Journal is a distinct credit to our Society is evidenced by the fact that the demand for complete sets became so great that three years ago the Council authorized the reprinting of the first five volumes. These volumes had been out of print for some time. The income from the sales of the reprinted volumes and of complete sets has more than counter-balanced the expenditures involved. While this outcome is financially very gratifying, it is of greater importance to know that complete sets of the Miner-

alogist are now widely distributed and much more accessible to scientists the world over than formerly. In addition, the usability of the Journal has been greatly facilitated by the publication of an author-subject decennial index for the period 1916-1925. The practice of issuing such an index for every ten volumes should be continued. Furthermore, the well established regularity with which the Journal now appears each month is without doubt greatly appreciated by the membership of the Society.

During the period under consideration the Society has been fortunate in the choice of its officers. The fact that there have been but few changes in the offices of the secretary, treasurer, and editor has permitted the development of a continuity of policy which has proven very beneficial. The affairs of the Society have been handled with great care and foresight. Although there has been material expansion in some of the activities of the organization, which added to our expense, the funds have been so efficiently husbanded that they have been substantially increased with the result that our assets now exceed \$50,000. We are greatly indebted to those officers who have guided the Society's affairs so wisely and who have ever sought to give it the standing among the scientific organizations of the country that it so justly deserves. Thus, it is a source of great satisfaction to know that we have been accorded representation on the National Research Council.

The election by the Council, in 1925, of Professor Edward Salisbury Dana, of Yale University, as honorary president for life met with the hearty and enthusiastic approval of the Society. By this very fitting recognition of the achievements of a leader in our science not only was a most distinguished name in American mineralogy more closely linked with the organization but the Society also honored itself. Likewise, the policy adopted by the Council in 1926 of electing from time to time as honorary fellows for life men in other countries who have been conspicuous in the advancement of mineralogy is strongly to be commended. Thus far, nine eminent mineralogists representing five countries have been honored, of whom one, Professor Paul H. von Groth, has since died.

In ten years the Society has achieved much, in fact, much more than the most enthusiastic advocate of its organization had dreamed or hoped for. Through the annual meetings opportunities have been given for the presentation of papers and the ex-

change of ideas and opinions, not previously possible. Then, too, these meetings have permitted workers in our field in the United States and Canada to come into personal contact with the result that a splendid *esprit de corps* has been developed. Furthermore, thanks to the Roebling endowment, the Society is now assured in the American Mineralogist of an adequate outlet for the rather prompt publication of papers. This is of great value since a decade or two ago it was often necessary to send them abroad in order to secure their early publication.

Although the success of the Society has been noteworthy, there is still much that may be accomplished. Among other things, it is sincerely hoped that during the next decade some of our members or friends will emulate Colonel Roebling by contributing funds to assist the Society in some of its other objectives, for example, in the more direct encouragement of research. It would be very helpful if the Society had the means to establish awards, either medals or money prizes, to be given to outstanding investigators in America or abroad, or to the authors of contributions adjudged as noteworthy. To be the recipient of a medal or prize of the Mineralogical Society of America would soon be recognized as a signal honor, one that would be greatly coveted. It would also be well if it were possible for the Society to make grants from time to time of varying amounts of money to assist in the prosecution of problems in our field, deemed of large importance. Furthermore, to stimulate interest in mineralogy on the part of young investigators the establishment of competitive fellowships would be of great service. These are a few suggestions as to the need for additional funds and how they might be used to advantage in furthering our science. Other needs undoubtedly will occur to many of you.

While today we rejoice that the achievements of the Society have been so significant during the first ten years, we are at the same time confident that the next decade will show equal or even greater accomplishments. This will be readily possible if we maintain the same enthusiastic interest in the science and the splendid loyalty and spirit of co-operation that have been so marked since our organization.

HÜBNERITE FROM KENDALL, MONTANA.*

D. J. FISHER, *University of Chicago.*

Specimens of what appear to be a somewhat altered light-colored porphyry or breccia sent to Mr. L. S. Ries of the University of Chicago by Mr. Frank B. Bryant, E. M., of Kendall (Hilger), Montana, were turned over to the writer for determination. They contain sharp-walled veinlets of hübnerite, which also lines small cavities in the rock. Mr. Bryant kindly furnished the following description:

"This mineral (hübnerite) is from the Gold Queen group operated by Wunderlin Brothers. The property is in Fergus County, about 18 miles north of Lewistown, in sec. 29, T. 18 N., R. 18 E., practically in the center of the North Moccasin Mountains of Montana. These mountains are a small laccolithic uplift about 4 (E-W) by 5 (N-S) miles in size. A mass of dacite (or rhyolite) porphyry, intruded into the upper shales of the Cambrian, is now exposed in a roughly circular area about two miles in diameter. The gold ores of the Kendall district occur in the topmost member of the Madison limestone (Mississippian; 1200 feet thick). The Devonian is missing, only a thin stratum of Silurian is known, and the maximum exposed thickness of the Cambrian is 200 feet.

The mineral (hübnerite) comes from a breccia dike at least 200 feet wide and 1500 feet long (NW-SE). It is composed principally of fragments of the intrusive rock, but some are of quartzite and Cambrian limestone. They average one to two inches across, but range up to four inches, and are cemented by some lime mineral. Pyrite cubes are abundant in the fragments of the intrusive, and later "amorphous" pyrite is plentiful in cavities and small fissures. Very subordinate amounts of galena and sphalerite are found; this is especially true of the better ore. The dark mineral (hübnerite) is evidently congenital with the ore-bearing solutions, as its relative abundance is indicative of the gold content. It (the hübnerite) is scattered heterogeneously through a width of 12 feet of the ore body, but shows its greatest concentration along an indistinct line of fissuring

* Paper presented at the tenth annual meeting of the *Mineralogical Society of America*, Washington, D.C., December 26, 1929.

near the foot wall. The gold values are erratic, varying from \$2.00 to \$9.00 per ton."¹

As the habit of the hübnerite crystals is different from any shown by Goldschmidt,² they were examined on the two-circle reflecting goniometer in conjunction with other tests made on the material. The crystals are wedge-shaped and in general appear similar to some of those shown by Hess and Schaller³ from Nederland, Colorado, except the latter are about twice as large. Detailed examination, however, shows the presence of three new prism forms, as well as a rare form recorded by but two other writers.⁴

The following table gives the results of the goniometrical study on one crystal. Only two crystals suitable for measurements were obtained, and unfortunately both of these were lost during examination by students; one crystal was not measured before its loss, while the other was studied when it was thought to be a pseudomorph after manganite with a peculiar facial development. Since the prism faces are so badly striated, the crystal was mounted on the goniometer with $c(001)$ normal to the pin. When later work demonstrated that the material was monoclinic, it was necessary to compute the observed readings as if rotated $28'$ about the b -axis, as shown in the following table.

Figure 1 gives a somewhat diagrammatic conception of the crystal habit, though the crystals are rather thinner or more

¹ The Judith Mountains, some six miles east of and geologically very similar to the two Moccasin Mountains, have been described by W. H. Weed and L. V. Pirsson in the *U. S. Geol. Survey 18th. Ann. Rept.*, Pt. III, pp. 437-616, 1898. *Mineral Resources of the U. S. (U. S. Geol. Survey)*, annual volumes for 1905 and later years, covers the gold production from this area (Fergus County). See also Freeman, O. W., *The North Moccasin Mountains of Montana, Mining and Engineering World*, vol. 42, pp. 947-49, 1915.

² Goldschmidt, V., *Atlas der Krystallformen*, IX, 1923.

³ Hess, F. L., and Schaller, W. T., *Colorado Ferberite and the Wolframite Series*, *U. S. Geol. Survey, Bull.* 583, Plate VII B, 1914. In this paper Schaller has described 12 new forms, but through oversight Goldschmidt has not recorded these in the reference cited above.

⁴ *U. S. Geol. Survey, Bull.* 624, p. 183, 1917, lists hübnerite from the following four Montana localities: Philipsburg, Potosi District (Madison County), Sugarloaf Mountain (Powell County), and Butte. A. N. Winchell has described the optical properties of the Butte hübnerite (*Econ. Geol.*, vol. 5, pp. 163-65, 1910). J. T. Pardee (*U. S. Geol. Survey, Bull.* 725, pp. 141-179, 1922) has briefly described the manganese deposits of Montana.

TABLE I. GONIOMETRICAL STUDY OF HUBNERITE

Forms	Face		No.	Quality ^s	Readings Observed		Observed Readings Rotated 28' on <i>b</i> -axis		Goldschmidt Calculated Readings	
	Symbol				Phi	Rho	Phi	Rho	Phi	Rho
	Gdt.	Miller								
<i>c</i>	<i>o</i>	001	10	<i>d</i>	—	0° 00'	90° 00'	0° 28'	90° 00'	0° 28'
<i>j</i>	$\overline{6} \infty$	$\overline{6}10$	8	<i>d</i>	262° 45'	90° 13'	262° 45'	89° 45'	262° 10'	90° 00'
	$\overline{6} \infty$	$\overline{6}10$	6	<i>v</i>	276° 26' ±	91° 25'	276° 26' ±	90° 57'	277° 50'	90° 00'
<i>J*</i>	$\frac{3}{2} \infty$	320	2	<i>v</i>	61° 2' ±	87° 46'	61° 3' ±	88° 13'	61° 10'	90° 00'
	$\frac{1}{2} \infty$	$\overline{3}20$	7	<i>e</i>	242° 11'	87° 46'	242° 10'	87° 19'	241° 10'	90° 00'
	$\frac{3}{2} \infty$	$\overline{3}20$	5	<i>d</i>	297° 57'	90° 44'	297° 58'	90° 17'	298° 50'	90° 00'
<i>P*</i>	$\infty \overline{4}$	$\overline{14}0$	11	<i>d</i>	164° 56' ±	87° 8'	164° 46' ±	87° 34'	165° 6'	90° 00'
<i>T*</i>	$\infty \overline{5}$	150	12	<i>e</i>	167° 56'	87° 26'	168° 6'	87° 52'	167° 59'	90° 00'
<i>t</i>	$\frac{1}{2} 0$	102	9	<i>m</i>	$\left\{ \begin{array}{l} 88^{\circ} 16' \text{ to} \\ 89^{\circ} 9' \end{array} \right.$	$\left\{ \begin{array}{l} 26^{\circ} 36' \text{ to} \\ 28^{\circ} 48' \end{array} \right.$	$\left\{ \begin{array}{l} 88^{\circ} 16' \text{ to} \\ 89^{\circ} 9' \end{array} \right.$	$\left\{ \begin{array}{l} 27^{\circ} 4' \text{ to} \\ 29^{\circ} 16' \end{array} \right.$	90° 00'	28° 3'

⁵ *d*, dim, but definite; *e*, very dim; *m*, multiple; *v*, multiple for phi but single value for rho.

* New forms.

tabular || to *a* than here shown. The zone parallel the *c*-axis is gently double convex lens-shaped in cross-section, with numerous vertical striations due to oscillatory combination of prism forms. The basal pinacoid is very narrow, and generally appears curved (in a vertical plane including the *b*-axis) due to the presence of many small irregular sub-parallel faces, but a fairly good signal is given by the central portion of the face. The hemi-orthodome *t*(102) is badly curved and only multiple images were obtainable; however, these fall within such limits as to leave no doubt about the symbol for the face. It is possible that a front hemi-bipyramid is present on some crystals, but a satisfactory signal could not be obtained. Neither of these upper faces is striated, but both show irregularities as described for *c*.

The form *j* (610), first described by Bøggild,⁶ was also noted by Schaller.⁷ On the Montana specimen this form is represented by two faces, one of which is quite wide (0.2 mm.) and smooth, though it did not give a strong reflection of light; one other face of this form furnished a signal, but elsewhere the striations are too close to permit sufficient light to be reflected.

⁶ Bøggild, O. B., *Mineralogia Grönlandica; Meddelelser om Grönland*, No. 32, p. 179, 1905. Bøggild used *p* for this form, but *p* had previously been used by Moses for (214). Goldschmidt uses α , but Schaller's letter *j* has priority.

⁷ Hess, F. L., and Schaller, W. T., *op. cit.*, p. 53.

Form *J* (320) is new, but there is no doubt of its identity, as it is represented by three faces which gave signals; one of these faces, the largest prismatic face on the crystal, is 0.3 mm. wide. Faces of this form also seem to be present on many crystals as very shiny but narrow rectangles in the position of *P* or *T* of Figure 1.

The new forms *P* (140) and *T* (150) are each represented by a single narrow face, about as shown in Figure 1, except that they extend only part way along the edge of the crystal. Each of these faces gave a definite signal, and the agreement between observed

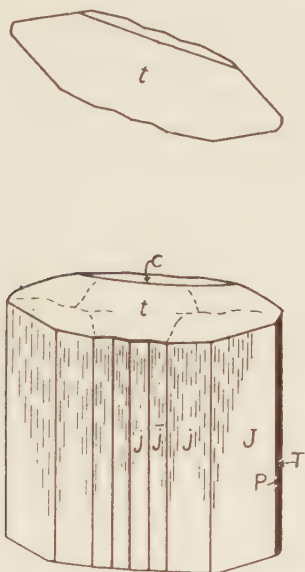


FIG. 1. Orthographic and clinographic projections of hübnerite from Montana. The crystal is about 1 mm. wide.

and recorded values seems as good as could be expected from such a small highly striated crystal.

Very few specimens of this Montana hübnerite show any cleavage, though a few grains had the typical (010) cleavage. Under the binoculars the fracture is semi-conchoidal, and the fractured surfaces have a splendid sub-adamantine, luster resembling the shiny portions of anthracite. Macroscopically the luster is sub-metallic, the color shiny gray-black (rutile red in certain lights), and the streak like ground coffee. The hardness of the crystals appears to be 4, or very slightly less; this is distinctly lower than is given

in the textbooks. Under the microscope the finer grains are amber brown with faint pleochroism to slightly reddish brown.

Warming in HCl after fusion with soda furnishes a yellow residue of WO_3 , as shown by the tin test. The mineral fuses at about 3 to a dull black, non-magnetic globule.⁸ The qualitative ammonia test for iron resulted in such a small precipitate that it is believed safe to regard the mineral as a hübnerite (not over 20% FeWO_4)⁹ rather low in iron. It gave a typical manganese reaction in the Na_2CO_3 bead and (for the oxidizing flame) in the borax bead; for the latter in the reducing flame, however, the yellow due to tungsten masked the normal colorless manganese bead. The salt of phosphorus bead tests¹⁰ were unsatisfactory from the point of view of indicating any known element present; the results follow:

Oxidizing flame	{ Hot—rich, amber brown.
	{ Cold—same, but slightly paler.
Reducing flame	{ Hot—rich brown.
	{ Cold—same, but deeper; nearly black in center.

Other properties are in conformity with the textbook descriptions.

Dr. P. M. Harris of the Department of Chemistry kindly made an X-ray spectrograph (24-hour exposure) of the finely ground powder of the mineral mounted between celluloid films.

Measurements of the spacings of the atomic planes in Ångstrom units follow:

SPACING	EST. INT.	SPACING	EST. INT.	SPACING	EST. INT.
5.75	1	1.72	5	1.14 ^o	1
4.75	5	1.67	0.5	1.12 ^o	0.5+
3.75	6	1.59	1—	1.10 ^o	0.5+
3.35	0.5	1.51 ^s	3+	1.08	0.5
2.95	10	1.47 ^o	3—	1.04	0.5
2.48	5	1.44 ^o	3—	1.02	1.5
2.38	2—	1.38 ^o	2—	0.99	0.5
2.22	4	1.33 ^o	2—	0.96	0.5
2.05	2—	1.28 ^o	0.5	0.93	0.5
2.01	2	1.25 ^o	0.5	0.91	0.5
1.88	1+	1.23 ^o	0.5	0.88	0.5
1.83	1+	1.19 ^s	1	0.83	0.5
1.77	2				

⁸ This might be taken by some to indicate absence of iron, but Hess (*op. cit.*, p. 8) has shown that many ferberites fuse to a non-magnetic globule.

⁹ Hess, F. L., *op. cit.*, p. 37.

¹⁰ These results differ somewhat from Dana, *System*, p. 984, 1892.

PROCEEDINGS OF THE TENTH ANNUAL MEETING OF THE
MINERALOGICAL SOCIETY OF AMERICA
AT WASHINGTON, D. C.

FRANK R. VAN HORN, *Secretary*.

The Mineralogical Society of America held its tenth annual meeting on December 26 and 27, 1929, in conjunction with the Geological Society of America at the Wardman Park Hotel, Washington, D. C. On Thursday, December 26, at 2:00 P. M., President A. L. Parsons called the regular annual meeting to order. On motion of the Secretary the reading of the minutes of the last annual meeting was dispensed with, in view of the fact that they had been printed on pages 95-107 of Volume 14 (Number 3) of *The American Mineralogist*.

ELECTION OF OFFICERS AND FELLOWS FOR 1930

The Secretary announced that 171 ballots had been cast unanimously for the officers as nominated by the Council. For fellows there was a unanimous vote of 73 ballots in the affirmative. All officers and fellows were declared elected.

The officers elected for 1930 are the following:

President: Herbert E. Merwin, Geophysical Laboratory, Washington, D. C.

Vice-President: John E. Wolff, Pasadena, California.

Secretary: Frank R. Van Horn, Case School of Applied Science, Cleveland, Ohio.

Treasurer: Albert B. Peck, University of Michigan, Ann Arbor, Michigan.

Editor: Walter F. Hunt, University of Michigan, Ann Arbor, Michigan.

Councilor, 1930-1933: Paul F. Kerr, Columbia University, New York City.

The fellows elected follow:

Dr. Gregori Aminoff, Director of the Mineralogical Department of the State Museum of Natural History, Stockholm, Sweden.

Dr. Clifton S. Corbett, Geologist, The Gulf Oil Company, 21 State St., New York City.

Mr. Edward P. Henderson, Assistant curator of Applied Geology in the U. S. National Museum and Lecturer in Mineralogy, Georgetown University, Washington, D. C.

Dr. John T. Lonsdale, Professor of Geology, Texas Agricultural and Mechanical College, College Station, Texas.

Dr. J. F. Schairer, Physical Chemist, Carnegie Institution of Washington, Geophysical Laboratory, Washington, D. C.

Dr. Stephen Richarz, Professor of Geology, St. Mary's College, Techny, Illinois.

Prof. Hyrum Schneider, Associate Professor of Geology, University of Utah, Salt Lake City, Utah.

Dr. Max N. Short, Assistant Geologist, United States Geological Survey, Washington, D. C.

Dr. Harry von Eckerman, Lecturer in Mineralogy and Petrology at the University of Stockholm, Sparreholm, Sweden.

REPORT OF THE SECRETARY FOR 1929

To the Council, Fellows and Members of the Mineralogical Society of America:
 The Secretary herewith begs to report that the roll of the Society now comprises 114 fellows and 274 members in good standing. One fellow and 27 members have been dropped from the mailing list for non-payment of dues, so that there is a gain of 8 fellows and 39 members for the year. No deaths have been reported during the year. In addition to the 388 fellows and members, there are 199 subscribers, a gain of 14 for the year. A total of 587 paid copies of the Journal are mailed monthly, an increase of 61 over last year and the largest annual gain in the history of the Society. Actually, during the past year 9 fellows, 80 members and 18 subscribers or a total of 108 were added, but 1 fellow, 27 members and 10 subscribers or a total of 38 were dropped from the mailing list. The general status of the Society is very gratifying.

Respectfully submitted,

FRANK R. VAN HORN, *Secretary.*

REPORT OF THE TREASURER FOR 1929

The Treasurer read his report, and on motion made and seconded, it was accepted and ordered filed. On motion an auditing committee composed of non-members of the Council was appointed by the President. This committee consisting of P. F. Kerr and M. W. Sensius later reported to the Secretary that they found the books of the Treasurer correct. The Treasurer's report follows:

To the Council of The Mineralogical Society of America: Your treasurer herewith submits his annual report for the year ending November 30, 1929:

RECEIPTS

Cash on hand December 1, 1928.....	\$2,424.42
Dues and subscriptions.....	1,893.05
Advertisements.....	213.00
Sale of back numbers.....	260.92
Interest on Endowment and bank deposits.....	2,481.14
Miscellaneous.....	2.50
	<hr/>
	\$7,275.03

DISBURSEMENTS

Printing and distribution of the Journal.....	\$2,825.96
To the Editor, Secretary, and Treasurer.....	700.00
Printing of separates.....	139.59
Miscellaneous.....	35.78
2 \$1000 Bonds, Trenton Mort. & Title Guar. Co. (5½%, due 1938).....	2,016.66
	<hr/>
	\$5,717.99

BALANCE in Princeton Bank and Trust

Co., Nov. 30, 1929..... \$1,559.72

Check #86 to W. L. Lemcke not returned to

bank..... 2.68 1,557.04

\$7,275.03

The Endowment consists of 45 one thousand dollar bonds of the City and County of

Honolulu.....	\$45,000.00
4 Liberty Bonds of \$100 each, 4th 4½%....	400.00
3 \$100 bonds of the Great Northern R. R. 5½ Gold.....	300.00
2 \$1000 bonds, Trenton Mort. & Title Guar. Co., 5½%, due 1937.....	2,000.00
2 \$1000 bonds, Trenton Mort. & Title Guar. Co., 5½%, due 1938.....	2,000.00
	<hr/>
	\$49,700.00

Respectfully submitted,

ALEXANDER H. PHILLIPS, *Treasurer*

REPORT OF THE EDITOR FOR 1929

The report was read by the Editor, and on motion it was accepted and ordered filed.

To the Council of the Mineralogical Society of America: This year is one of more than usual interest as it marks the tenth anniversary of the founding of the *Mineralogical Society of America*. It will be recalled that the *American Mineralogist*, sponsored largely by the Philadelphia Mineralogical Society, the New York Mineralogical Club and the Mineral Collectors' Association, made its first appearance in July 1916. With the organization of the Mineralogical Society of America in 1920 the *American Mineralogist* became the official publication of that body.

It is not my purpose to trace the development and expansion of the Journal during this ten year period as another speaker will cover this phase in presenting a general survey of the outstanding events that have transpired since the eventful organization meeting at Harvard University a decade ago. However, it might not be out of place to emphasize here the single point that although the Journal still fails, in some respects, to measure up to the ideals that are held for it by those in charge of its welfare, nevertheless substantial progress has been made, and from a periodical of approximately 200 pages in 1920 there has evolved a publication that under normal conditions should fill a volume of about two and a half times that size.

In this connection it is interesting to recall a statement made by the first President of the Society in his address "On the future of mineralogy." In referring to the Journal the speaker said: "It is hoped that as a result of the general readjustment of prices the issuing of monthly numbers of from 24 to 32 pages each may soon become possible." At that time and under the then existing circumstances this was believed a worthy goal considering the high printing costs and the meagre income of the Society. This goal has been reached and passed due largely to a generous endowment in 1926 by the late Col. Washington A. Roebling, and instead of issues of from 24 to 32 pages, numbers of from 45 to 50 pages each are now not uncommon.

Turning to an analysis of volume 14 we find that while the publications of the Journal for the current year have failed to establish new records for either total

size or for the number of articles published, still the performance for 1929 might be considered as satisfactory. Last year, due to favorable circumstances which permitted the issuance of one very large number of 170 pages, volume 13 was somewhat larger. Although no opportunity for a special number was presented during the present year, nevertheless volume 14 contains approximately 500 pages and represents the largest volume in the history of the Society with the single exception noted above.

During the past year 37 individuals have contributed one or more of the 74 leading articles that have appeared in the current volume. Forty-five of these articles came from contributors within the States while two were received from Canada. The contributions have not been restricted to a few institutions but have come from 22 different universities, research bureaus and technical laboratories. Of the 47 leading articles, 3 recorded for the first time descriptions of new mineral species; 4 described famous mineral localities; 20 called attention to new data on established species and 20 consisted of addresses and articles of a miscellaneous character including a number on crystal structure.

The 47 leading articles occupied 396 pages or 81% of the total space, while 19 book reviews, 24 reports of proceedings of societies, 38 abstracted accounts of new mineral names and 63 other items of general interest, including numerous short articles, filled 93 or 19% of the space of the Journal.

The Editor wishes to take this opportunity to state that suggestions for improving the Journal are always welcome. During the past year a number have been received that were of material assistance in producing a better balanced and more serviceable magazine. More attention has been given to book reviews with the result that the number published (19) represents a fair increase over other years. Also the annual index has been enlarged by including references to all minerals containing new physical, chemical or optical data. In many instances these descriptions are deeply buried in the text proper and their presence would not be suspected from the title of the article containing them. These are some of the minor refinements which may pass unnoticed by the casual reader but which should be of considerable assistance to the serious minded student.

During the latter part of the year there has been a regrettable delay on the part of the publishers in printing and distributing authors' reprints. Every effort is now being made to insist upon delivery within a period of 30 days from date of publication. A letter recently received from the publishing company states that a new press has been installed that will be devoted almost exclusively to their reprint business. This should speed up the filling of reprint orders and I feel quite confident that in the future there will be a marked improvement in this direction.

In conclusion it should be noted that the reports of both the secretary and treasurer indicate that during the year there has been a gratifying increase in the number of members added to our mailing list and also in the receipts from dues and subscriptions. Indications at present seem very bright for 1930. It is hoped that a year hence the Editor will be able to announce a volume of at least 600 pages, but whether this goal is to be realized or not depends largely upon the number and size of suitable manuscripts received from the members and friends of the Society.

The concluding table of contents summarizes the distribution of subject matter in volume 14.

DISTRIBUTION OF SUBJECT MATTER IN VOLUME 14

Subjects	Articles	Pages	Per cent of Total
Leading articles			
New mineral species	3		
Mineral locality articles	4		
New data on established species	20		
Addresses and miscellaneous articles	20		
	—		
	47	396	81
Proceedings of societies	24	36½	19
Notes and news	63	31½	
Book reviews	19	13	
Abstracted accounts of new mineral names	38	12	
	—	—	—
Total of text	191	489	100
Illustrations	145		
Covers, advertisements, index		103	
		—	
Total		592	

Respectfully submitted,
WALTER F. HUNT, *Editor.*

REPORT OF SPECIAL COMMITTEE REVIEWING THE REPORTS OF THE COMMITTEE ON NOMENCLATURE AND CLASSIFICATION OF MINERALS

W. T. Schaller, Chairman, read the report of the Committee which follows:

This committee was formed largely on the initiative of its Chairman. Its object was to consider the several reports presented in past years by the Committee on Nomenclature and Classification, select the more important features thereof and again present them to the Members of the Society in an effort to have them adopted, perhaps aiding this effort by giving to the Editor certain powers with reference to the carrying out of such selected features in the Journal of our Society.

With this end in view, the Chairman preliminarily read and reread the various reports of the previous Committee, trying to attain the desired end, as just outlined to you. He felt that whether or not the report of his Committee be adopted, such a report, making specific recommendations based on the earlier reports of the previous Committee, would in all probability be the last report on such a subject. He therefore considered the subject a grave and important one, requiring careful thought. He is glad to say that the other two members of this Committee fully agree in his characterization of the subject.

In reviewing the various reports of the previous Committee, it is noted that there was not always uniformity of decision of the entire committee; several of the items were favored "by the majority of the Committee, though not by all." It seems therefore as if further consideration can still be given, with profit, to certain of the several topics considered.

Moreover, there have recently been two new developments which bear directly on this matter:

The first is that a new edition of Dana (the 7th) is well under way. The authors of the volume (or volumes?) will have to consider all the points brought out in the Committee's reports and come to a decision on all of them. Could not cooperation between the authors of the new Dana and the resurrected Committee make further progress?

The second is that the next International Geological Congress, in 1932, will be held here, probably in Washington. Can not we then have a real meeting of a mineralogical and petrographical section and discuss international questions in mineralogy, such as nomenclature and classification?

The Chairman of the previous Committee, Dr. H. S. Washington, in his letter of October 12, 1924, to fellow committeemen, said:

"Spencer (that is L. J. Spencer of the British Museum) strongly advocated the formation of a joint committee or some sort of close working and understanding between English and Americans, and then to consult and work with the French, etc." Such an international committee would carry out the idea of Prof. Kraus expressed at the Ithaca meeting in 1924 when his motion was carried "that a Subcommittee of our Committee on Nomenclature be appointed by its Chairman to cooperate with a similar British Committee."

It has therefore seemed to the present Committee that this is not an opportune time to present again the items covered in the earlier reports of the previous Committee but that it would be much better to continue the work of the previous Committee, with special consideration of the preparation of the new edition of Dana and the coming International Geological Congress in 1932.

This Committee therefore recommends the appointment of a new Committee on Nomenclature and Classification whose duties shall be similar to those of the previous Committee but who shall, in addition, offer to cooperate with the authors of the new edition of Dana and shall also offer to cooperate on germane subjects with the other mineralogical societies of the world, starting with the Mineralogical Society of Great Britain, and shall present a report, either final or preliminary, at the next International Geological Congress in Washington in 1932.

W. T. SCHALLER, *Chairman*

CLARENCE S. ROSS

EDGAR T. WHERRY

It was moved and carried to adopt the recommendation of the Committee. The President appointed the following: W. T. Schaller, W. F. Foshag, E. S. Larsen, T. L. Walker, E. T. Wherry and A. N. Winchell.

REPORT OF REPRESENTATIVE ON THE NATIONAL RESEARCH COUNCIL

The representative of the Society, W. T. Schaller, gave a brief summary of the work of the National Research Council and some of its committees during the year.

REPORT OF THE DELEGATES TO THE XV INTERNATIONAL GEOLOGICAL CONGRESS

T. L. Walker, Chairman, read the following report:

The Fifteenth Congress was opened on the 16th of July 1929, in Cape Town where the members were welcomed by the Mayor in the City Hall. After two days spent on excursions in the Cape peninsula most of the members left Cape Town on excursions to study the geology on the way to Pretoria where the sessions lasting from July 28th to August 7th were held. During the sessions numerous short excursions were held in the vicinity of Pretoria, to be followed by longer excursions to North and South Rhodesia, the Bushveld Complex, Zululand and to the Vredefort granite dome. About 350 of the total of 500 members were in attendance from about 50 countries and colonies. The excellent arrangements made by the General committee for the advantage and comfort of the visitors were highly appreciated by the members. The delegates from the Mineralogical Society of America—E. P. Henderson, A. H. Phillips, Frank R. Van Horn and T. L. Walker—thank you for the privilege of representing our society at this great gathering which included many of the leaders in our field.

T. L. WALKER, *Chairman*

NEW BUSINESS

It was moved and carried that the congratulations and best wishes of the Society be extended to our Honorary President, Professor Edward S. Dana, New Haven, Connecticut, on having attained his 80th birthday, November 16, 1929.

It was also moved and carried that the Society show its appreciation to its retiring Treasurer, Alexander H. Phillips, by a rising vote of thanks.

PRESENTATION OF PAPERS

At 2:55 P. M., there being no further business, the Society proceeded to the reading of scientific papers. The papers presented with short abstracts follow:

E. H. KRAUS, Past President: *The First Ten Years of the Mineralogical Society of America*. This very interesting and instructive summary of the history of the Society is published in this number of the Journal.

C. B. SLAWSON: *A Biological Application of Petrographic Methods*. In studying the therapeutic effects of phenolphthalein and its derivatives the Pharmacology and Pharmacy departments of the University of Michigan could devise no satisfactory chemical test for the detection of dihydroxy-benzophenone in urinary precipitates. By identifying the crystals with the petrographic microscope it was found possible not only to identify the crystals but to make a quantitative estimation of the amount eliminated.

R. H. LOMBARD and H. E. MERWIN: *Minerals of the System Cu-Fe-S*. (Presented by H. E. Merwin.) Mixtures of copper and iron sulphides have been heated in sulphur vapor at various temperatures and pressures. The relations of the compounds and solid solutions found have been studied for the range 460°–950° in detail. For the range 50°–460° the study is less complete because of polymorphic changes, slowness of reaction, and the “unmixing” of solid solutions.

K. K. LANDES: *Rapid Specific Gravity Determinations with Clerici Solution.* Clerici solution, a thallium malonate-formate, has the double advantage over other heavy liquids in its complete miscibility with water and in its unusually high specific gravity (4.4 plus). A series of 25 test tubes were mounted in a block and liquids with gravities ranging from 2.0 to 4.4, in steps of .1, were put inside. The mineral fragment to be tested is placed on a concave and porous disk which is soldered to a vertical rod. The rod is lowered into the tube and the relative density of the mineral secured. The specific gravity of a mineral can be determined to an accuracy within .03 inside of 30 seconds. If kept tightly stoppered and covered with a black cloth when not in use the variation of the liquids after a lapse of one year will not exceed .01.

D. J. FISHER: *Hübnerite from Kendall, Montana.* Hübnerite from the North Moccasin Mountains shows three new prism forms, *J* (320), *P* (140), and *T* (150), as well as the rare form *j* (610). The physical and chemical properties of the material are described, along with the data from an X-ray spectrograph of the powder. This paper is printed in full in this issue.

During the latter part of the afternoon session in the absence of the President, Vice President Edward Wigglesworth presided.

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At 3:55 P. M. the Society adjourned to the Theater of the Hotel to attend a joint session with the Geological Society of America at 4 P. M. before which the presidential address of Professor Arthur L. Parsons on "*Iridescent Color in Peristerite*" was given. This paper is published in full in this number. Following this address with A. L. Parsons presiding, papers of the Geological Society of a mineralogical and petrographical nature were presented. The joint session adjourned at 6 P. M.

On Friday, December 27, at 9:20 A. M., President Parsons called the second session of the Society to order, and the reading of papers proceeded according to program.

C. E. MILLER: *Separation of Mica from Kaolin Clay Sand Residues by Rosenbusch's "Cardboard Method."* The paper describes apparatus designed to hold the material, upon which the mica is quantitatively separated from the sand, at a definite angle of slope. The apparatus permitted the use of various materials. Glass, glazed and unglazed, bristol board, sheet mica, and bond paper were used.

The best separation was obtained by using glazed bristol board, while glass was not quite as satisfactory. Quantitative separations of mica, 80 mesh or coarser, are possible by this method and require less time and skill than other methods of separation. It is suggested that micas finer than 80 mesh be separated by means of a glazed porcelain funnel or dish.

C. E. MILLER and B. C. GETCHELL: *Data Concerning Decrepitating Minerals.* Believing that occluded water and gas were not the sole causes of decrepitation, a survey of the mineralogical literature, American, English, and German was made. Thirty-two mineralogical references and textbooks out of 75 examined used the term "decrepitation" in describing the pyrognostic properties of minerals. Four Industrial publications mentioned decrepitation as a means of separating economic minerals from their gangue minerals. Three papers dealing with causes of decrepitation were found. Two hundred and eleven minerals were described as decrepitating.

A list giving the frequency, system and authorities is given. No one reference contained more than 55.6% of the decrepitating minerals.

Analysis of the data shows (1) that from their origin decrepitating minerals may well contain occluded water but this is offset by the large number of minerals containing occluded water that do not decrepitate, (2) that crystal system and water of composition cannot be the sole causes of decrepitation, (3) that available data for the decrepitating minerals show them to be brittle.

The results of the analysis lead to the suggestion that anyone of three combinations or sets of conditions may be responsible for decrepitation.

J. E. WOLFF: *Lantern Slides in Natural Colors for Demonstrating Geology and Microscopical Petrography*. Lantern slides made by the author on natural color plates were projected, illustrating Southern California geology, both in the San Gabriel Mts. above Pasadena, the Mohave Desert, Death Valley, etc., and similarly of thin sections of rocks under the microscope, either with crossed nicols, polarizer only, or both successively. These were made for easy demonstration to elementary classes or lay audiences to illustrate structural or textural features.

SYMPOSIUM ON CLAYS

At 10:10 A.M. the regular program of the Mineralogical Society was interrupted, and those present listened to a joint program on clays consisting of papers taken from the programs of both the Mineralogical and Geological Societies. This symposium was presided over by President A. L. Parsons and Vice-President Edward Wigglesworth of the Mineralogical Society.

Geological Society Paper: C. S. ROSS AND P. F. KERR: *Review of our Present Knowledge of the Clay Minerals*.

Geological Society Paper: S. B. HENDRICKS AND W. H. FRY: *The Result of X-Ray and Microscopic Examination of Soil Colloids*.

Mineralogical Society Paper: H. E. MERWIN: *Staining as an Aid in the Determination of Clay Minerals*. Several stains make clay minerals conspicuous. The state of aggregation of the clay rather than its crystal structure affects the rate and depth of staining, and also the rate and amount of penetration of liquids.

Mineralogical Society Paper: P. F. KERR: *Kaolinite from a Brooklyn Subway Tunnel*. A white clay discovered in a subway tunnel excavation near Newtown Creek, L. I., was found to be kaolinite. It occurs beneath glacial till, as a weathering product of the Ravenswood granodiorite. It is associated with greenish less altered areas of weathered granodiorite containing vermiculite. The decay of the rock and the later formation of kaolinite were probably both produced by pre-glacial weathering.

The occurrence provides a description of a typical residual kaolin composed essentially of the mineral kaolinite as strictly defined. Emphasis is placed upon the necessity of careful identification in the case of kaolinite in order to distinguish the mineral from closely related species.

Geological Society Paper: L. G. WESTGATE: *The White Clays of Southern Ohio*. It is shown that the white clays, which are usually less than two feet in thickness, grade down into the underlying mantle rock, whether that is Illinoian or Wisconsin till or residual material from the decay of either limestone or sandstone; contain no

fragments that cannot be found in the underlying mantle rock; occur on upland flats at all elevations up to the tops of the highest cuesta flats and knob outliers of the region; and that they have been produced by the surface weathering of any kind of clayey mantle rock occurring on level tracts of poor drainage.

Mineralogical Society Paper: J. L. STUCKEY: *The Mineralogy of Some Deposits of Kaolinized Volcanic Ash from the Slate Belt of North Carolina*. The rocks of the Carolina Slate Belt consist essentially of acid volcanic flows, tuff, breccia and ash, all strongly metamorphosed. Associated with the areas of ash are irregular lenses of a light colored clay-like material commonly called kaolin. Microscopic study of this material shows it to be an impure, residual clay composed largely of quartz, kaolin, and sericite with small amounts of other minerals and some partly altered rock fragments were present.

Mineralogical Society Paper: F. R. VAN HORN: *China Clay Deposits at St. Austell, Cornwall, England*. Lantern slides were projected which showed the great extent of the deposits, and the methods of purification of these large masses of kaolinite which are among the most important in the world.

Geological Society Paper: V. T. ALLEN: *Petrography of the Weathered Zones of Glacial Deposits*. In the upper part of the profile clay minerals are formed at the expense of the feldspars and the ferromagnesian minerals and these belong to the isomorphous series, recognized by Larsen and others, with beidellite $\text{Al}_2\text{O}_3 \cdot \text{SiO}_2 \cdot n\text{H}_2\text{O}$ and nontronite $\text{Fe}_2\text{O}_3 \cdot 3\text{SiO}_2 \cdot n\text{H}_2\text{O}$ as end members. The optical properties and the chemical analyses of carefully prepared samples of gumbotil from Fairfield, Iowa and Salem, Illinois are similar to those of beidellite from the type locality, Beidell, Colorado. Under better drainage conditions beidellite-nontronite is moved downward probably as colloid solutions which are deposited in cracks and cavities. The cleavage plates are orientated parallel to the sides of the deposits and the optical properties suggest that the composition of the different layers varies between that of nearly pure beidellite and that in which the proportion of Al_2O_3 to Fe_2O_3 is about 1:1 molecularly.

At 12:22 P. M., after finishing all clay papers of both Societies, the regular program of the Mineralogical Society was resumed.

R. C. EMMONS: *The Double Variation Method of Mineral Determination*. In the identification of crystalline substances by means of their optical constants the determination of their refractive indices is probably of paramount importance. The ease and increasing accuracy of these determinations lends this method certain distinct advantages over chemical analyses. The methods outlined in this paper are intended to contribute to the speed and accuracy of such procedures.

In making a determination of refractive index on the petrographic microscope by immersion methods the combined variation of temperature and wavelength of light used affords not merely a greater index range of a given liquid but it yields data on the dispersion of the crystal being studied. Also it makes it unnecessary to determine the index for 589μ as this can be read by interpolation from the resulting curve of dispersion. By using the universal stage in addition to these other controls the crystal grain may be oriented in successive positions such that all critical indices may be read on it alone unless the birefringence is high.

J. E. WOLFF: *The Fedorow Universal Stage for Determining the Optical Properties of Minerals, especially in Sections of Rocks*. A short description was given of the Universal stage and of some of the methods (elaborated by Berek) for determining the optical characters of minerals in thin section, which are largely graphic or require but the simplest calculations.

At 12:58 P. M., the Society adjourned for lunch, and at 2:12 P. M., resumed the reading of papers according to program.

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L. S. RAMSDELL: *The Crystal Structure of Tetradymite*. An X-ray study has been made of the sulfides, selenides and tellurides of arsenic, antimony and bismuth, with the general formula A_2B_3 . Of the nine compounds studied, Bi_2Te_3 , Bi_2Se_3 , Sb_2Te_3 and As_2Se_3 are isomorphous and have a structure which closely approximates a simple rhombohedral arrangement. This simple rhombohedron has the form of a cube, slightly elongated along a trigonal axis. All of the structural positions are equivalent, and are occupied by A and B atoms, in the proportion of 2:3, with a random distribution. The unit cell contains 1 atom, which has an atomic weight of $A_2B_3/5$.

E. C. PALMER: *Flints and Jaspers Found in the District of Columbia in 1929*. The paper described the discovery of flints, chalcedonies and jaspers on the shore of the Potomac River near the famous Key bridge on the District of Columbia side, while inspecting two old British bronze cannons that had been found at the bottom of a hole dug for the purpose of placing foundation piers for a wharf and building. Nine trips were made to the spot during April and May, 1929, and 248 lbs. were brought away covering all sizes up to 137 ounces.

Many of the specimens are covered with a white coating which, with their unique shape, make them resemble closely the flint nodules taken from the chalk cliffs of England.

J. E. WOLFF: *Dumortierite from Imperial County, California*. Specimens of a quartz-dumortierite rock have been repeatedly found on the plains of the Colorado Desert, N. to N. E. of Ogilby, Imperial Co., California, and therefore N.E. of the Colorado river at Yuma, Arizona, but outcrops have so far never been located. This specimen was found in a shallow wash, descending from a mountain range to the N.E. A general account of the locality is given, a description of the specimen, and the optical characters of the dumortierite.

E. T. WHERRY: *A Tabulation of the Aluminum Silicate Minerals*. The tabulation of the aluminum silicate minerals published in the *American Mineralogist* in June, 1925, needs revision in the light of recent discoveries. A new diagram, constructed on the same basis as the old one, is presented. The most striking changes consist in the recognition of the variability in alumina to silica ratio with individual species.

E. H. KRAUS, WILLIS SEAMAN, and C. B. SLAWSON: *Two New Minerals from the Lake Superior Iron District*. These two hydrated boro-phosphates were found in the Chicagoan mine. The manganese boro-phosphate crystallizes in excellent orthorhombic crystals with a pale wine yellow color. The second mineral is apparently an alteration product of the first, magnesium replacing the manganese. It is a white asbestos-like mineral which occurs in felted masses or rodlike aggregates.

F. R. VAN HORN: *Replacement of Wolframite by Scheelite in a Cornish Tin Vein.* In September 1929, while on a rather hurried visit to some of the tin mines of Cornwall, England, Captain M. T. Taylor of the East Pool Mine, near Camborne, gave the writer a specimen which was very interesting. It consisted of the following minerals in their probable order of importance: quartz, wolframite, scheelite, arsenopyrite, pyrrhotite, chalcopyrite, fluorite, chlorite and cassiterite. The wolframite is partially or wholly altered or replaced by a pinkish mineral which seems to consist, at least in part, of scheelite.

W. F. FOSHAG: *Origin of Boron Deposits of the Western United States.* The boron deposits of the western United States are accumulations of borates and other minerals in the playas of closed basins. The original mineral is often ulexite. In some of the Tertiary deposits this mineral is an important one but in others it is changed entirely, or in part, to colemanite. In a previous paper the writer suggested that this colemanite is derived from the ulexite after the uplift and tilting of the beds by percolating saline solutions. It is now believed that the colemanite was derived from the ulexite while the beds were still in the playa stage, the splitting of the ulexite into the soluble borax and the insoluble colemanite being brought about by the separation of the soluble from the insoluble constituents as the playa passed, in its history, from the wet to the dry stage. This process explains more fully the physical and chemical features of these boron deposits.

M. N. SHORT: *Some Discredited and Doubtful Ore Minerals.* Owing to the absence of the author, this paper was read by title.

E. K. GEDNEY: *Notes on the Mineralogy of the New England Pegmatites.* A description of various mineralogical features of interest observed during a four months' study of the pegmatites of New England. Special consideration is given to certain larger mines and to the very large occurrences of blue albite and golden beryl at the Allan Mine, Alstead, New Hampshire.

E. K. GEDNEY: *Beryllium Ores in New England.* A discussion of beryllium and its uses, its geologic occurrence and the probable amount of the metal to be found in New England. Special descriptions of the larger deposits are given. The huge 18 foot crystals of beryl at Albany, Me., the quarry at Georgetown, Me., and Beryl Mountain, N. H., are described in detail. Evidence is presented indicating that the beryls of Albany and other localities are of two generations: one a late, hydrothermal type characteristic of pocket deposits, and the other apparently the first mineral in the pegmatite to crystallize.

A. F. ROGERS: *Distribution of Crystals Among the 32 Symmetry Classes.* (Read by P. F. Kerr.) Of the 7200 odd crystalline substances (both minerals and prepared compounds of the laboratory) described in Groth's *Chemische Kristallographie*, (5 vols. 1906-1919), 5588 have been assigned to a particular crystal class, most of them with a reasonable degree of certainty.

A statistical study of these 5588 crystalline substances reveals a number of interesting facts. In the order of number of representatives, the crystal classes are arranged as follows: Monoclinic prismatic, rhombic bipyramidal, triclinic pinakoid-al, rhombic bisphenoidal, monoclinic sphenoidal, hexagonal scalenohedral, rhombic pyramidal, ditetragonal bipyramidal, asymmetric, monoclinic domatic, etc. Each of these has more than 20 known representatives; the other classes have fewer than 20 each.

The monoclinic prismatic class has 2786 representatives, or 49% of the total. The first five classes named have together nearly 92% of the total number. It is surprising to learn that the asymmetric class (triclinic pediad) is ninth in the list. In other words, there are 22 crystal classes, each with fewer representatives than the asymmetric class.

E. T. WHERRY: *A Plea for the Improvement of the Names of the Crystal Forms*. The names of the crystal forms in common use lack uniformity and in some cases are unnecessarily complicated, ambiguous, or even incorrect. A series of names is accordingly proposed, to arouse discussion, in which these objections are partly avoided. Some of the guiding principles are: Closed forms in the Cubic System should be named on the basis of number rather than shape of faces. The expressions 1st, 2nd, and 3rd order for forms in Tetragonal and Hexagonal systems are without real significance and should be replaced by descriptive terms. The same root name should be used for all interchangeable forms, all the forms in the Triclinic holosymmetric, for example, being really pinacoids; the positions in which they are oriented should be expressed by adjectives or prefixes applied to the fundamental term.

J. T. LONSDALE: *Euhedral Magnesite Crystals from Winkler County, Texas*. This paper describes the physical and chemical properties of small crystals of magnesite recovered from well cores of dolomitic limestone from Winkler County, Texas. The occurrence is believed to constitute the second find in the United States of euhedral crystals of magnesite.

A. C. HAWKINS: *Crystallized Minerals in a Meteorite*. In the siderolite from Estherville, Iowa, the nickel-iron is crystallized in octahedrons. Also there is a dark fused crust on the outside of the stony portion, and cavities within. Lining the cavities are crystals of olivine, magnetite, hematite, topaz, and corundum, all showing a number of familiar faces and in the case of the topaz a very large number of additional forms. Cracks caused by the explosion of the meteorite are evidently later than the period of crystallization.

J. L. GILLSON: *Genesis of the Peekskill Emery Deposits*. The emery deposits near Peekskill, N. Y., have long attracted scientific attention because of the complexity of the rock types and the variety of the mineralogy there found. In recent years these emery deposits have been cited by Bowen as an outstanding example of the result of a reaction between a basic magma and an aluminous sediment. The present study indicates that the striking mineralogy was rather caused by common contact metamorphic processes. Volatile or liquid emanations from a lower part of the magma chamber passed through the solidified, igneous rock and out through the walls, causing changes in the mineralogy of both rock types. A sequence of mineral formation is established which proves the nature of the geologic process and dates the time of the ore and gangue formation. A number of minerals were identified, not previously known to occur in the district.

CHARLES PALACHE and L. H. BAUER: *The Occurrence of Beryllium in the Zinc Deposits of Franklin, New Jersey*. This paper was read by Harry Berman and was published in full in the January 1930 issue of the *American Mineralogist*.

L. S. BROWN: *Types, Occurrence and Probable Origin of Texas Celestite*. Celestite has long been known from Texas. It has a wide distribution, but geologic formations are not mentioned in any reported occurrences of the mineral. It has

been our observation that this mineral is restricted to the Glen Rose limestone (Lower Cretaceous). Evidence of syngenetic deposition is seen in a large nodule, which shows unfractured bending of soft strata both above and below, evidently caused by crystal growth.

The two crystal forms seem regularly distributed. A peculiar domatic type appears in the lower strata of the Glen Rose, whereas typical pinacoidal (basal) and prismatic crystals are common in the upper strata. It is suggested that the new type is due to recrystallization under pressure of accumulating sediments.

L. S. BROWN: *New Report on the Barringer Hill District of Texas*. The Barringer Hill pegmatite has had the distinction of producing several rare-earth minerals, some unique for the locality. Descriptions of minerals and the locality have been quite numerous, and have appeared many years ago.

The paper does not present new material. Its purpose is to recall attention to the locality in view of the fact that recently contemplated power projects are expected to submerge the "hill." Rare earth minerals are still to be obtained, though specimens are becoming very scarce.

L. H. BAUER and H. BERMAN: *New Data on Some Franklin, New Jersey, Minerals*. Results of recent analyses and investigations on the following minerals were given: zinc-manganese cummingtonite, apophyllite, celestite, clinozoisite, datolite, ferroschallerite, svabite and barysilite.

S. RICHARZ: *A Peculiar Blue-Green Amphibole from the Metamorphic Iron Formation of the Eastern Mesabi Range, Minnesota*. In the absence of the author, this paper was read by title.

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The last paper was finished at 6:15 P. M., after which it was moved that the thanks of the Society be extended to the Local Committee and to the authorities of the United States National Museum for their kindness and hospitality. This was unanimously adopted. The Society then adjourned.

During the sessions of the Society, a total of 35 scientific papers were presented. 51 fellows, 34 members and 20 guests registered at the meetings, making a total of 105. The following registered at the meetings:

J. L. Adler, W. M. Agar, V. T. Allen, E. T. Apfel, Miss Florence Bascom, W. B. Bayley, H. Berman, A. Bevan, M. Billings, H. R. Blank, I. C. Brown, L. S. Brown, E. L. Bruce, A. F. Buddington, W. H. Callahan, I. Campbell, Mrs. W. L. Capps, Miss G. M. Carhart, R. W. Clark, R. J. Colony, C. S. Corbett, L. W. Currier, H. T. Davis, Miss R. Doggett, A. H. Emery, R. C. Emmons, G. L. English, G. T. Faust, C. R. Fettke, D. J. Fisher, L. W. Fisher, W. F. Foshag, R. E. Fuller, S. L. Galpin, E. K. Gedney, J. L. Gillson, J. Gilluly, E. F. Goldston, F. A. Gonyer, W. A. P. Graham, O. R. Grawe, J. W. Greig, C. S. Gwynne, E. T. Hancock, A. C. Hawkins, E. P. Henderson, F. L. Hess, D. F. Hewett, A. P. Honess, W. F. Hunt, H. Insley, E. C. Jacobs, P. F. Kerr, E. H. Kraus, J. D. Kraus, G. F. Kunz, A. C. Lane, E. S. Larsen, H. Leighton, J. H. C. Martens, E. B. Mathews, H. E. Merwin, B. L. Miller, C. E. Miller, W. J. Miller, E. S. Moore, J. F. Morton, W. H. Newhouse, T. B. Nolan, E. C. Palmer, A. L. Parsons, A. B. Peck, E. H. Perkins, A. H. Phillips, R. S. Poor, L. S. Ramsdell, R. Heinrich, C. H. Richardson, C. S. Ross, E. Sampson, J. F. Schairer, W. T. Schaller, F. C. Schrader, M. W. Senstius, M. N. Short, C. B. Slawson, M. H. Stow, J. L. Stuckey, J. H. Swartz, M. R. Thompson, E. Thomson, D. W. Trainer, Jr., F. R. Van Horn, T. L. Walker, H. S. Washington, R. C. Wells,

L. G. Westgate, E. P. Wheeler, 2nd, E. T. Wherry, W. Wigglesworth, A. N. Winchell, J. E. Wolff, J. F. Wright, G. Zuloaga.

LIST OF FORMER OFFICERS AND MEETINGS, WITH DATES

By recommendation of the Council, a complete list of past officers is printed in the proceedings of the annual meeting of the Society.

Honorary President for Life..... Edward S. Dana, 1925.

PRESIDENTS

1920 Edward H. Kraus
1921 Charles Palache
1922 Thomas L. Walker
1923 Edgar T. Wherry
1924 Henry S. Washington
1925 Arthur S. Eakle
1926 Waldemar T. Schaller
1927 Austin F. Rogers
1928 Esper S. Larsen
1929 Arthur L. Parsons

SECRETARIES

1920-1922 Herbert P. Whitlock
1923 Frank R. Van Horn

VICE-PRESIDENTS

1920 Thomas L. Walker
1921 Waldemar T. Schaller
1922 Frederick A. Canfield
1923 George F. Kunz
1924 Washington A. Roebling
1925 Herbert P. Whitlock
1926 George Vaux, Jr.
1927 George L. English
1928 Lazard Cahn
1929 Edward Wigglesworth

TREASURERS

1920-1923 Albert B. Peck
1924-1929 Alexander H. Phillips

EDITORS

1920-1921 Edgar T. Wherry
1922—— Walter F. Hunt

COUNCILORS

1920 Arthur S. Eakle, Frank R. Van Horn, Fred E. Wright, Alexander H. Phillips.
1921 Frank R. Van Horn, Fred E. Wright, Alexander H. Phillips, Austin F. Rogers.
1922 Fred E. Wright, Alexander H. Phillips, Austin F. Rogers, Thomas L. Watson.
1923 Alexander H. Phillips, Austin F. Rogers, Thomas L. Watson, Esper S. Larsen.
1924 Austin F. Rogers, Thomas L. Watson, Esper S. Larsen, Arthur L. Parsons.
1925 Thomas L. Watson, Esper S. Larsen, Arthur L. Parsons, William F. Foshag.
1926 Esper S. Larsen, Arthur L. Parsons, William F. Foshag, William A. Tarr.
1927 Arthur L. Parsons, William F. Foshag, William A. Tarr, Alexander N. Winchell.
1928 William F. Foshag, William A. Tarr, Alexander N. Winchell, Ellis Thomson.
1929 William A. Tarr, Alexander N. Winchell, Ellis Thomson, Clarence S. Ross.

ANNUAL MEETING PLACES

1920 Chicago, Illinois
1921 Amherst, Massachusetts
1922 Ann Arbor, Michigan
1923 Washington, D. C.
1924 Ithaca, New York
1925 New Haven, Connecticut
1926 Madison, Wisconsin
1927 Cleveland, Ohio

1928 New York, New York
1929 Washington, D. C.

NOTES AND NEWS

PROFESSOR DANA HONORED ON HIS EIGHTIETH BIRTHDAY.

On the occasion of his eightieth birthday, November 16, professor-emeritus Edward S. Dana, honorary president of the Mineralogical Society of America, was the recipient of congratulatory messages sent him by the Mineralogical Society of America and the Vienna Academy of Sciences, in recognition of his scientific achievements as an eminent investigator, author and editor. The letters received by Professor Dana are herewith printed in full.

Professor E. S. Dana, Honorary President,
The Mineralogical Society of America.

Dear Sir:

The Council, Fellows and Members of the Mineralogical Society of America in session at their tenth annual meeting at Washington, D. C., wish to congratulate you on having attained your eightieth birthday on November sixteenth. We wish for you continued health, and the enjoyment of many other birthday anniversaries.

FRANK R. VAN HORN, *Secretary*.

To our highly honored Colleague:

In accordance with a beautiful old custom, the Academy of Sciences in Vienna sends you the heartiest good wishes for the 16th of November, 1929, the day on which you complete your eightieth year in perfect physical and mental vigor. May the years, so rich in scientific achievement, which lie behind you, be followed by a long and happy autumn of life made beautiful and enhanced by the love and devotion of all those who are permitted to have a part in your life. Among these, the members of the Academy of Sciences in Vienna count themselves and with pride place the name of Edward Salisbury Dana among their foreign members.

Such an anniversary prompts us to look back on the past, and many would be inclined to regard the year 1876 in which you obtained your degree of doctor of philosophy at Yale University as the beginning of your scientific career. Indeed, from that year on, link by link, the chain was forged of important contributions concerning the varied minerals of your country.

However, for us in Vienna this year of 1876 has not the same significance, since we recognized that forerunners of those excellent works had already been developed in Vienna. . . . Thus, since the relationship between yourself and Vienna dates back to the year 1874, we of Vienna may rightfully claim Edward S. Dana as one of ourselves.

As a collaborator in the supplements of the 5th Edition of the famous "System of Mineralogy," of your eminent father, James Dwight Dana, you were well prepared to revise this work and give it a form adapted to the requirements of modern times. This revision was completed in 1892 and,

with it, you have produced a fundamental work, which commands the greatest respect and the widest distribution throughout Europe.

No less favorably than through your own work have you influenced the progress of science as editor of the venerable "American Journal of Science" (started by your grandfather in 1818), which presents to the scientific world the progress of your countrymen in the realm of Natural Science, with strong emphasis on Geology. Because of the careful choice of articles, the accuracy of references, and the forceful method of presentation, the readers of each number of the "American Journal of Science" have ever experienced profound satisfaction; further, the leading position of this journal in the world cannot be questioned.

However, the members of the Vienna University circle have very special reason for remembering you with gratitude on this Anniversary. Since 1873 bonds of personal friendship have been formed between you and a number of physicists and mineralogists in Vienna.

With this circle of friends you have kept faith during one of the saddest times which Vienna and Austria have ever experienced. In the fatal years of the gradual breakdown of the Austrian Empire, during which the State was unable to protect Austrian scholars of world-wide fame and their families from bitter need, you have remembered your friends and, with the courage of a kind heart, have been one of the first to collect funds for the support of your starving colleagues in Vienna and for the amelioration of their distress. The members of the Academy of Vienna cannot fail to testify to this publicly on the present occasion, and we ask you to accept their gratitude for the help and sympathy shown through the past ten years.

Vienna, November 16th, 1929.
The Academy of Sciences in Vienna.

President,
OSWALD REDLICH

Secretary,
R. SCHWINDLER
General Secretary,
L. RADERMACHER

To the corresponding member of the Vienna Academy of Sciences.
Professor Dr. Edward Salisbury Dana.

The Mineralogical Museum of Harvard University has purchased from Dr. Gustav Flink a large collection of minerals from Långban, Sweden. This collection has been brought together since 1924 when a similar series was acquired from Dr. Flink by the State Museum at Stockholm. It consists of upwards of six thousand specimens; of these about one-third represent species already described and two-thirds are of the so-called "numbers," that is specimens containing minerals possibly or probably new to science and requiring investigation.

Many "numbers" are represented by from ten to fifty specimens so that there is good promise that material sufficient for their precise determination is available; and even if but a small proportion of the "numbers" prove to be species, it is evident that the collection is of more than usual mineralogical interest.

PROCEEDINGS OF SOCIETIES

NEW YORK MINERALOGICAL CLUB

Minutes of the Meeting of December 18, 1929

A regular monthly meeting of the New York Mineralogical Club was held at the American Museum of Natural History on the evening of December 18, 1929, with an attendance of 29. First Vice-President Frederick I. Allen presided in the absence of the President.

Messrs. Samuel Butler, George E. Dunlop, and S. Benedict Levin, of New York City, Thomas Rea of Brooklyn, and Joseph J. Stegle of Bronxville, N. Y., were elected to membership.

The speaker of the evening was Mr. J. W. Radu, a member of the Club, who discussed "*The Radium Mines of Joachimsthal, Czecho-Slovakia.*" The mines are situated in the Erzgebirge, near the Saxony border, in a region of mica schists and slates, penetrated by igneous rocks. The radium ore (uraninite or pitch-blende) occurs associated with dolomite in veins in the schist. The mines have been worked intermittently since the 16th century, first for silver and lead, but more recently for uranium and radium exclusively. The radium produced is practically free from mesothorium.

The speaker described his trip through the mines, and praised the hospitality of the management. He exhibited a number of excellent specimens of the uraninite.

Mr. Morton exhibited minerals from various localities in Virginia, and reported finding erythrite at West Paterson and native silver at the Prospect Park quarry, Paterson, New Jersey.

HORACE R. BLANK, *Secretary*

Minutes of the Meeting of January 15, 1930

A regular monthly meeting of the New York Mineralogical Club, attended by 50 persons, was held at the American Museum of Natural History on the evening of January 15, 1930, with 1st Vice-President Frederick I. Allen in the chair.

Miss Litta L. Voelchert, of New York City, was elected to membership.

Dr. Edward Sampson, of Princeton University, addressed the Club on "*Some Mineral Deposits of Southern Africa.*" After briefly outlining the geology of South Africa, he discussed the diamond-bearing pipes and other objects of interest in the vicinity of Kimberley, such as the alluvial diamond diggings, the salt pans, and Permian glaciated surfaces.

The gold mines of the Rand were discussed at some length, the speaker favoring the theory of the placer origin of the gold, and emphasizing the success of geologic work in locating extensions of the ore-bearing "reefs."

The Bushveld complex of igneous rocks, and the ores which accompany it, were then described. Tin ores, accompanied by tourmaline, occur in pipes. Platinum ores occur in banded norite, in dunite pipes, as contact deposits, and in pegmatites. Sperrylite, in large crystals, and the still rarer minerals stibiopaladinite and cooperite occur in these deposits.

Occurrences of chromite and asbestos were also touched upon.

The lecture was illustrated by a series of lantern slides, a number of excellent maps and charts, and a large group of specimens representative of the minerals and rocks described.

HORACE R. BLANK, *Secretary*

PHILADELPHIA MINERALOGICAL SOCIETY

Academy of Natural Sciences, December 5, 1929

A stated meeting of the Philadelphia Mineralogical Society was held on the above date, Mr. Charles R. Toothaker presiding. Upon favorable recommendation of the Council Messrs. Albert Ackoff, James R. Eichna and Henry Guenst were elected to Junior Membership. The names of Messrs. H. E. McNelly, A. E. Mason and Norman Booker were proposed for membership. The president read excerpts of an article on "Semi-precious Stones in the Soviet Union." Mr. Frederick H. Oldach addressed the meeting on "*Minerals in Pegmatite Veins.*" Beginning with the molten magma the speaker outlined the process of differentiation, introductory to the classification of the solidified magmas. He stressed the importance of studying the melting point of pure minerals and mixtures of minerals. Specific examples of the various pegmatite types were shown and at the same time attention was called to the peculiar presence or absence of certain minerals or groups of minerals in closely related types. A short discussion followed. Several junior members displayed some very attractive quartz crystals recently found near Bridgeport, Pa., and Mr. Williams showed beryl of unusual quality from Leipserville. Attendance 62.

LESTER W. STROCK, *Secretary*

BOOK REVIEW

SEDIMENTARY PETROGRAPHY. HENRY B. MILNER. Second revised and complete edition. XXI+514 pages with 41 plates. Thomas Murby & Co., London; D. Van Nostrand Co., New York, 1929. Price \$8.50.

Mineralogists and petrologists will welcome the appearance of the second edition of this excellent work on sedimentary petrography. No longer will it be necessary for the student to make time consuming shifts from the "Introduction" (published in 1922) to the "Supplement" (published in 1926) and *vice versa* in order to obtain all the recorded information. However, the present volume is not a mere blending into one book of the material previously disseminated through two smaller texts. Naturally most of the descriptions and cuts of the earlier works have been embodied in the second edition after careful revision. At the same time entirely new chapters have been added so that in its present form the book can serve as a comprehensive treatise on the petrology of both the consolidated as well as the unconsolidated sediments. In fact one chapter of approximately 100 pages is devoted exclusively to a systematic description of *thin sections* of sedimentary rocks.

The book in its present form consists of eleven chapters with three appendices. While it is difficult to give an adequate review in the space allotted, some idea of the wide scope of the work may be gained from the following chapter headings: (1) Introduction to the study of sedimentary rocks; (2) Surface and subsurface samples, storage and records; (3) Laboratory technique; (4) Microscopical examination of

sediments; (5) Quantitative data; (6) Diagnostic properties of sedimentary rock minerals; (7) The petrography of consolidated sediments; (8) The principles and practice of differentiation and correlation of sediments by petrographic methods; (9) Some examples of differentiation and correlation of sediments by petrographic methods; (10) The bearing of sedimentary petrography on palaeogeographical problems; and (11) The application of sedimentary petrography to the study of soils and related superficial deposits.

In this edition 72 minerals are fully described and of this number 55 are represented by figures. Forty-one full page glazed inserts carrying photomicrographs of thin sections, individual minerals and mineral assemblages contribute much to the value of the text for instructional purposes. The usefulness of the book can be still further extended through the purchase from the publishing house of complete sets of microscope slides illustrating the various phases of sedimentary petrology as described in the text.

The book is strongly recommended to every serious student of sedimentary rocks irrespective of his special line of interest, although the price of \$8.50 seems excessive if the same book can be purchased for twenty-one shillings in England.

W. F. H.